

NASA TECH BRIEF

Marshall Space Flight Center



NASA Tech Briefs announce new technology derived from the U.S. space program. They are issued to encourage commercial application. Tech Briefs are available on a subscription basis from the National Technical Information Service, Springfield, Virginia 22151. Requests for individual copies or questions relating to the Tech Brief program may be directed to the Technology Utilization Office, NASA, Code KT, Washington, D.C. 20546.

Ellipsometer Measurements of Epitaxial GaAs Layers: A Concept

Epitaxial GaAs films are used in the fabrication of some solid-state circuits and devices. One major area includes the fabrication of magnetic bubble-domain memory systems. In this case, the thickness and uniformity of the film are critical and must be thoroughly analyzed to obtain proper system performance. This analysis is usually accomplished with ellipsometers that measure refractive indices of thin films to derive film thickness and uniformity. Unfortunately, the current mathematical analyses of such data are only good for isotropic films. Epitaxial GaAs films are thought to be anisotropic, and therefore they cannot be analyzed by the existing methods.

A theoretical study has been conducted to see if an ellipsometer can be constructed to evaluate the anisotropic films. The results of this study are published in a report. The report discusses a generalized approach in evaluating a reflection matrix for an arbitrary, but known, surface or for a combination of arbitrary surfaces and films. The analysis involves Maxwell's equations formed in a 6-by-6 matrix. By applying boundary conditions at proper points in the sample, the equation for the propagation of light through an anisotropic medium is reduced to an eigenvalue problem resulting in a 4-by-4 matrix.

A program was developed to solve this type of problem. By introducing artificial optical constants as parameters, it has been substantiated that ellipsometers can be used for the analysis of anisotropic films. The following conditions have to be observed: First, data have to be recorded at several angles of incident light, and second, data have to be obtained at several orientations of the sample relative to the plane of incidence. Currently, work is underway to develop an infrared ellipsometer unit for the analysis of anisotropic films. The polarizer and analyzer for such a device have already been tested successfully.

Note:

Requests for further information may be made in writing to:

Technology Utilization Officer
Marshall Space Flight Center
Code AT01
Marshall Space Flight Center, Alabama 35812
Reference: B75-10230

Patent status:

NASA has decided not to apply for a patent.

Source: D. J. DeSmet of
University of Alabama
(MFS-23238)

Categories: 01 (Electronics - Components
and Circuitry)
03 (Physical Sciences)